

## (9) CLAIMS

1. An electronically addressable display comprising:

a substrate;

associated with the substrate, an addressable display bi-modal molecular colorant  
5 stratum; and

associated with the molecular colorant stratum, an addressing device mounted for  
selectively switching colorant molecules of the stratum between at least two visually  
distinguishable states.

2. The display as set forth in claim 1 comprising:

10 a first of said two distinguishable states is a transparent state.

3. The display as set forth in claim 2 comprising:

a second of said two distinguishable states is an opaque color state.

4. The display as set forth in claim 1, said bi-modal molecular colorant stratum  
comprising:

15 a molecular system, said system including electrochromic, switchable molecules,  
each of said molecules being selectively switchable between said at least two optically  
distinguishable states, wherein said system is distributable on the substrate thereby  
forming a display screen region.

5. The display as set forth in claim 1 comprising:

said colorant molecules exhibit an electric field induced band gap change.

6. The display as set forth in claim 5 comprising:

said electric field induced band gap change occurs via a mechanism selected from a group including (1) molecular conformation change or an isomerization, (2) change of extended conjugation via chemical bonding change to change the band gap, and (3) molecular folding or stretching.

7. The display as set forth in claim 5 comprising:

said electric field induced band gap change occurs via a molecular conformation change or an isomerization.

8. The display as set forth in claim 7 wherein the molecules forming the molecular system further comprise:

at least one stator portion and at least one rotor portion, wherein said rotor rotates from a first state to a second state with an applied electric field, wherein, in said first state, there is extended conjugation throughout said molecular system, resulting in a relatively smaller band gap, and wherein in said second state, said extended conjugation is destroyed, resulting in a relatively larger band gap.

9. The display as set forth in claim 7 comprising:

dependent upon direction of electrical field applied, in a first of said states said colorant molecules are in a more conjugated state throughout, having a relatively smaller band gap, and in a second of said states said colorant molecules are in a less conjugated state throughout, having a relatively larger band gap.

10. The display as set forth in claim 5 comprising:

said electric field induced band gap change occurs via a change of extended conjugation via chemical bonding change to change the band gap.

11. The display as set forth in claim 10 comprising:

said electric field induced band gap change occurs via a change of extended conjugation via charge separation or recombination accompanied by increasing or decreasing band localization.

12. The display as set forth in claim 11 comprising:

a change from a first state to a second state occurs with an applied electric field, said change involving charge separation in changing from said first state to said second state, resulting in a relatively larger band gap state, with less p-delocalization, and recombination of charge in changing from said second state to said first state, resulting in a relatively smaller band gap state, with greater p-delocalization.

13. The display as set forth in claim 5 comprising:

said electric field induced band gap change occurs via a change of extended conjugation via charge separation or recombination and p-bond breaking or formation.

14. The display as set forth in claim 13 comprising:

5 a change from a first state to a second state occurs with an applied electric field, said change involving charge separation in changing from said first state to said second state, wherein in said first state there is extended conjugation throughout, resulting in a relatively larger band gap state, and wherein in said second state said extended conjugation is destroyed and separated positive and negative charges are created,  
10 resulting in a relatively smaller band gap state.

15. The display as set forth in claim 5 comprising:

said electric field induced band gap change occurs via a molecular folding or stretching.

16. The display as set forth in claim 15 comprising:

15 said colorant molecule has three portions, a first portion and a third portion, each bonded to a second, central portion, wherein a change from a first state to a second state occurs with an applied electric field, said change involving a folding or stretching about or of said second portion, wherein in said first state there is extended conjugation, resulting in a relatively smaller band gap state, and wherein in said second state, said extended

conjugation is destroyed, resulting in a relatively larger band gap.

17. The display as set forth in claim 1 comprising:

said colorant molecules are arranged to form discrete, addressable picture elements of said display stratum.

5 18. The display as set forth in claim 17 comprising:

said addressing device is configured for switching selected said picture elements between a transparent state and a colored state.

19. The display as set forth in claim 17 comprising:

10 said addressing device is configured for switching selected said picture elements between two visually distinctive color states.

20. The display as set forth in claim 1 comprising:

said colorant molecules are bistable, providing a non-volatile component.

21. The display as set forth in claim 1 comprising:

15 said colorant molecules have a low activation barrier between different said states providing a fast volatile switching therebetween.

22. The display as set forth in claim 1 comprising:

said colorant molecules have more than two said states, switchable such that optical properties of said stratum can be tuned either continuously by application of a decreasing or increasing electric field to form a volatile switch or color of selected display regions are changed abruptly by application of voltage pulses to switch at least one molecular activation barrier.

23. The display as set forth in claim 1 in a computer apparatus.

24. The display as set forth in claim 1 in an electronic appliance.

25. The display as set forth in claim 24 wherein said electronic appliance is an appliance in the group including test and monitoring instruments, musical instruments, telecommunications devices, personal computing devices, digital photographic devices, or image projection devices.

26. An electronic appliance comprising:

an appliance housing; and

incorporated with the housing, a display device, the display device including at least one writeable imaging stratum forming a pixel array of a bi-modal molecular colorant, and an addressing device mounted for selectively switching colorant molecules of the imaging stratum.

27. The device as set forth in claim 26 comprising:

adjacent said imaging stratum, a background stratum in black, white or a predetermined color, wherein said addressing device switches said colorant molecules between a transparent orientation and a color-exhibiting orientation such that said background stratum provides high contrast as viewed through the colorant molecules in the transparent orientation with respect to the colorant molecules in the color-exhibiting orientation.

28. The device as set forth in claim 26 comprising:

said imaging stratum further comprising colorant molecules having a first state wherein a picture element formed of said molecules in said first state are displayed in a first color, including black or white, and said colorant molecules having a second state wherein a picture element formed of said molecules in said second state are displayed in a second color, including white or black, presenting a visually high contrast to molecules in said first state.

29. The device as set forth in claim 26 wherein said appliance is selected from a group including computers, computing machines of both hard-wired, fixed location and portable types, calculators, electronic books, monitoring instruments, musical instruments or music stands, networked workstations, personal digital assistants, telephones, televisions, test instruments, video games, or wired or wireless communication devices.

30. The device as set forth in claim 26 comprising:

said display is a fixed geometry position screen.

31. The device as set forth in claim 26 comprising:

said display is a retractable geometry positionable screen.

5 32. The display as set forth in claim 26 comprising:

said colorant molecules are arranged to form discrete, addressable picture elements of said display stratum.

33. The display as set forth in claim 26 comprising:

said colorant molecules are bistable, providing a non-volatile component.

10 34. The display as set forth in claim 26 comprising:

said colorant molecules have a low activation barrier between different said states providing a fast volatile switching therebetween.

35. The display as set forth in claim 26 comprising:

said colorant molecules have more than two said states, switchable such that  
15 optical properties of said stratum can be tuned either continuously by application of a decreasing or increasing electric field to form a volatile switch or color of selected display regions are changed abruptly by application of voltage pulses to switch at least one



molecular activation barrier.

36. A visual display comprising:

at least one writeable imaging stratum forming a pixel array of a bi-modal molecular colorant; and

5 at least one addressing device mounted for selectively switching colorant molecules of the imaging stratum.

37. The device as set forth in claim 36 comprising:

adjacent said imaging stratum, a background stratum in black, white or a predetermined color, wherein said addressing device switches said colorant molecules  
10 between a transparent orientation and a color-exhibiting orientation such that said background stratum provides high contrast as viewed through the imaging stratum regions where the colorant molecules in the transparent orientation with respect to the colorant molecules in the color-exhibiting orientation.

38. The device as set forth in claim 36 comprising:

15 said imaging stratum further comprising colorant molecules having a first state wherein a picture element formed of said molecules in said first state are displayed in a first color, including black or white, and said colorant molecules having a second state wherein a picture element formed of said molecules in said second state are displayed in a second color, including white or black, presenting a visually high contrast to molecules

in said first state.

39. The device as set forth in claim 36 comprising:  
said display is a fixed geometry position screen.

40. The device as set forth in claim 36 comprising:  
5 said display is a retractable geometry positionable screen.

41. The display as set forth in claim 36 comprising:  
said colorant molecules are arranged to form discrete, addressable picture  
elements of said display stratum.

42. The display as set forth in claim 36 comprising:  
10 said colorant molecules are bistable, providing a non-volatile component.

43. The display as set forth in claim 36 comprising:  
said colorant molecules have a low activation barrier between different said states  
providing a fast volatile switching therebetween.

44. The display as set forth in claim 36 comprising:  
15 said colorant molecules have more than two said states, switchable such that  
optical properties of said stratum can be tuned either continuously by application of a

decreasing or increasing electric field to form a volatile switch or color of selected display regions are changed abruptly by application of voltage pulses to switch at least one molecular activation barrier.

45. The display as set forth in claim 36 comprising:

5 a plurality of imaging strata forming a display ensemble wherein each of said imaging strata includes a pixel array of a bi-modal molecular colorant such that colorant molecules thereof are selectively switchable between a transparent state and a primary color state, and

10 associated with each of said imaging strata, addressing devices mounted for selectively switching colorant molecules of respectively associated imaging stratum of said imaging strata.

46. The display as set forth in claim 36 comprising:

said imaging strata is a mosaic pattern of colorant molecules arranged in addressable picture element groups.

15 47. The display as set forth in claim 46 wherein said mosaic pattern is formed with ink-jet technology.

49. The display as set forth in claim 36, said addressing means comprising:  
molecular crossbar wiring.

50. A method of fabricating a rewritable display screen, the method comprising:  
depositing a substantially homogeneous layer of bi-modal molecular colorant on a  
surface; and  
providing addressable elements adjacent said surface for matrix addressing said  
5 surface as addressable picture elements.

51. The method as set forth in claim 50 comprising:  
forming the molecular colorant having electric field changeable colorant molecules.

52. The method as set forth in claim 51 comprising:  
providing said colorant molecules wherein said molecules are at least bi-modal.

10 53. The method as set forth in claim 51 comprising:  
providing said colorant molecules wherein said molecules are bistable.

54. The method as set forth in claim 50 comprising:  
forming each addressable picture element of a set of molecules wherein said  
colorant molecules exhibit an electric field induced band gap change.

15 55. The method as set forth in claim 54 comprising:  
inducing said band gap change via a mechanism selected from a group including  
(1) molecular conformation change or an isomerization, (2) change of extended

conjugation via chemical bonding change, and (3) molecular folding or stretching.

56. A method of document retrieval using an internet, the method comprising:  
from a telecommunications appliance, ordering the document over the internet;  
downloading the document from the internet into the telecommunications

5 appliance; and

displaying the document on a display associated with the telecommunications  
appliance by forming an image of the document on a pixel array of a rewritable bi-modal  
molecular colorant.

57. A method of doing business with respect to document publishing and retrieval, the  
10 method comprising:

providing a wireless communications site including a server for publishing  
document content; and

downloading from said site to a wireless telecommunications appliance document  
content data for read-only display by forming a selectable page-by-page pixel array on a  
15 bi-modal molecular colorant display associated with said appliance.

58. A wireless communications appliance, comprising:

a wireless interface;

a display screen having at least one writeable imaging stratum forming a pixel  
20 array of a bi-modal molecular colorant; and

at least one addressing device mounted for selectively switching colorant molecules of the imaging stratum.

59. The appliance as set forth in claim 58, said bi-modal molecular colorant comprising:

5 a molecular system, said system including electrochromic, switchable molecules, each of said molecules being selectively switchable between said at least two optically distinguishable states, wherein said system is distributable on the substrate thereby forming a display screen region.

10 60. The display as set forth in claim 58 comprising:  
said colorant molecules exhibit an electric field induced band gap change.

61. The display as set forth in claim 60 comprising:  
said electric field induced band gap change occurs via a mechanism selected from a group including (1) molecular conformation change or an isomerization, (2) change of  
15 extended conjugation via chemical bonding change to change the band gap, and (3) molecular folding or stretching.

62. A projection apparatus comprising:  
a display means for projecting an image, said display means having a transparent substrate and, associated with said substrate, at least one writeable imaging

stratum forming a pixel array of a bi-modal molecular system; and

associated with said imaging stratum, at least one addressing means for selectively switching colorant molecules of the imaging stratum forming an image for projection.

5 63. An electronically addressable display comprising:

a translucent substrate having a means for backlighting said substrate associated therewith;

associated with the substrate, an addressable display bi-modal molecular colorant system; and

10 associated with the molecular colorant system, an addressing means mounted for selectively switching colorant molecules of the system between at least two visually distinguishable states wherein one of said states produces a color of high contrast with respect to said translucent substrate and another one of said states is transparent.